

REMARKS

Applicants thank the Examiner for the thorough examination given the present application.

Claim 1-3 and 5-10 are pending in the present application. Claims 1 and 7 have been amended and claim 4 has been cancelled. No new matter has been added. No new matter has been introduced.

In view of the following remarks, reconsideration and withdrawal of the outstanding rejections are respectfully requested.

Priority Under 35 U.S.C. §119

Applicants thank the Examiner for acknowledging Applicants' claim for foreign priority under 35 U.S.C. §119, and receipt of the certified priority document.

Information Disclosure Citation

Applicants thank the Examiner for considering the references supplied with the Information Disclosure Statement filed July 19, 2006, and for providing Applicants with an initialed copy of the PTO/SB/08 form filed therewith.

Claim Rejection under 35 U.S.C. §112, second paragraph

Claim 7 is rejected under 35 U.S.C. §112, second paragraph as being indefinite. This rejection is respectfully traversed.

By way of the present amendment, this rejection is moot.

Claim Rejection under 35 U.S.C. §102(b)

Claims 1-3, 7 and 10 are rejected under 35 U.S.C. §102(b) as being anticipated by Mickols (USP 5,755,964, hereinafter "Mickols '964"). This rejection is respectfully traversed.

While not conceding to the Examiner's rejection, but to merely advance prosecution, independent claim 1 has been amended to further emphasize the distinctions between the present invention and the applied art.

The Present Invention and its Advantages

Claim 1 of the present invention is directed to a preparation method of a polyamide thin film composite (TFC) reverse osmosis membrane using interfacial polymerization of an amine aqueous solution and amine-reactive compound, the preparation method comprising the steps of: (a) forming a polyamide active layer through interfacial polymerization by contacting a surface of a porous support with the amine aqueous solution containing a polyfunctional aromatic amine monomer and an organic solution containing polyfunctional acyl halide monomer as an amine-reactive compound; and (b) performing post-treatment preceded by formation of the polyamide active layer by contacting the polyamide active layer with an aqueous solution containing 0.1 to 100 wt % of polyfunctional tertiary alcohol amine comprising at least two tertiary amines having substituted alcohol group on the hydrocarbon side chains.

According to the claimed invention, polyfunctional tertiary alcohol amine is used as a post-treatment compound and a high-temperature drying step is further performed after performing the post-treatment, thereby attaining the polyamide TFC reverse osmosis membrane having improved water permeability and salt rejection compared to the prior art using various post treatment agents or methods. See paragraph [0019] of US publication.

Distinctions Between the Present Invention and the Mickols '964 Reference

As explained above, the claimed invention includes features including, among others, performing post-treatment preceded by formation of the polyamide active layer by contacting the polyamide active layer with an aqueous solution containing 0.1 to 100 wt % of polyfunctional tertiary alcohol amine comprising at least two tertiary amines having substituted alcohol group on the hydrocarbon side chains.

Mickols '964 relates to a method of treating polyamide composite membranes with amines to increase the flux or flow rate through the membranes in a filtration operation.

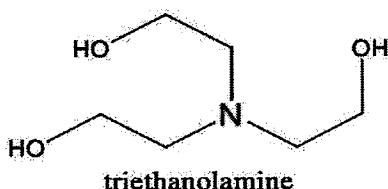
However, the claimed invention is patentably distinguishable from Mickols '964.

Specifically, the polyfunctional tertiary alcohol employed in the post-treatment step of the present invention comprises **at least two tertiary amines having substituted alcohol group on the hydrocarbon side chains** (emphasis added).

On the contrary, Mickols '964 uses triethanolamine (TEA), which comprises **only one tertiary amine**.

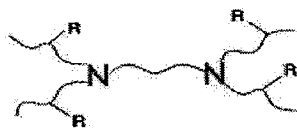
This distinction can be confirmed from the following comparative formulae.

<Mickols '964>

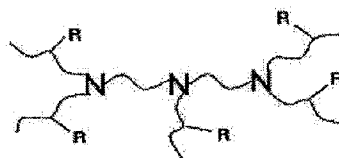


<The Present Invention>

[Formula 1]



[Formula 2]



As shown above, the claimed polyfunctional tertiary alcohol amine of the present invention is patentably distinguishable from TEA of Mickols '964 in view of the number of tertiary amine.

Therefore, claims 1-3, 7 and 10 of the present invention are not anticipated by Mickols '964.

Claim Rejections under 35 U.S.C. §103(a)

Claims 4-6 and 8-9 are rejected under 35 U.S.C. §103(a) as being unpatentable over Mickols. This rejection is respectfully traversed.

The Examiner has indicated at page 5 of the Office Action that it would have been obvious to a person of ordinary skill to modify the method taught by Mickols '964 by replacing the disclosed amines with their combination or with amines that have a plurality of hydroxyl and amino functional groups per molecule so as to obtain reverse osmosis (RO) membranes with maximum flux based on Column 5, lines 50-53 of Mickols '964. Applicants respectfully disagree with this indication.

Also, the Examiner has asserted that N, N, N', N'-tetrakis(2-hydroxyethyl)ethylenediamine can be viewed as a combination of triethanolamine and ethylenediamine, both of which are taught by Mickols. Applicants respectfully disagree with this assertion for the following reasons.

Unlike a composition comprising several compounds, one may not guarantee that each property of a chemical compound could be maintained when several chemical compounds are combined. Therefore, Applicants respectfully submit that the Examiner's assertion that the claimed polyfunctional tertiary alcohol amine is a combination of amines disclosed in Mickols '964 appears to be exaggerated.

In addition, Mickols '964 does not motivate or suggest one to combine triethanolamine and ethylenediamine. Specifically, embodiments of Mickols '964 remain silent about use of the combined amines. If Mickols '964 would expect the improved results (water permeability and salt rejection rates) of combined amines, this applied art would have had such explicit embodiments.

Also, there are many kinds of amines having a plurality of hydroxyl and amino functional groups per molecule. Mickols '964 merely discloses that performing post-treatment with amines which have a plurality of hydroxyl and amino functional groups per molecule can elevate flux. However, Mickols '964 fails to specifically disclose or suggest the polyfunctional tertiary alcohol amine for amine, which has a plurality of hydroxyl and amino functional groups per molecule.

Further, Mickols '964 is presented as background art in the present specification. Applicants recognized that although many substituted alcohol groups in side chain of tertiary amine enhances the water permeability, these groups also lower the salt rejection rate. Accordingly, Applicants researched and

found that the claimed polyfunctional tertiary alcohol amine can solve these problems and completed the present invention.

When an amine such as TEA of Mickols '964 is used as a post-treatment compound, the salt rejection rate of the reverse osmosis membrane undesirably decreases due to the number of alcohol groups substituted at terminals of tertiary amine side chains while the water permeability of the reverse osmosis membrane increases. For example, see paragraph [0014] of the corresponding US publication.

To the contrary, since the claimed invention utilizes at least two tertiary amines, the claimed amine compound has more substituted alcohol groups than TEA of Mickols '964 having only one alcohol group existing at the terminal of a tertiary amine side chain. Therefore, the water permeability of the claimed membrane is noticeably improved as compared to TEA of Mickols '964.

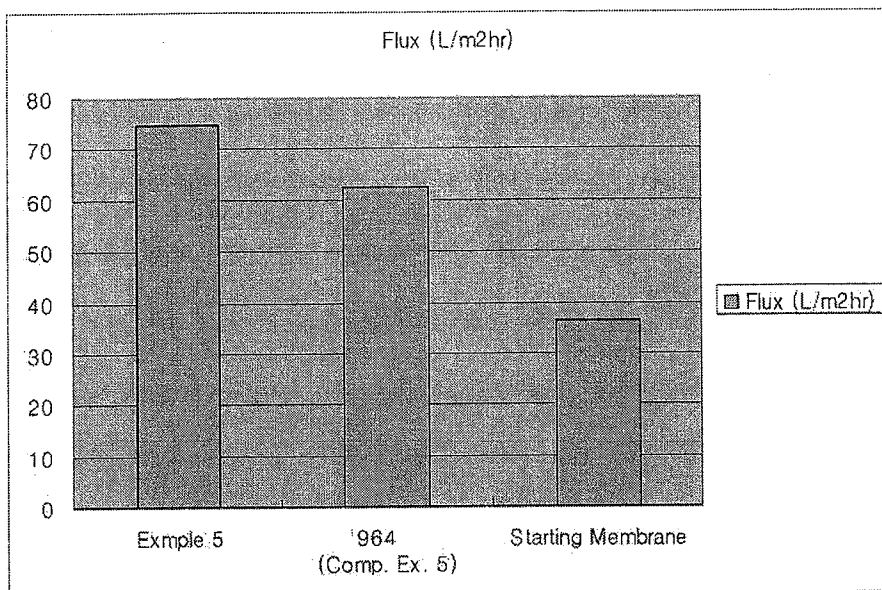
Furthermore, when the claimed post-treatment is followed by a high-temperature drying step, reduction of the salt rejection rate can be minimized. This is because polyfunctional tertiary alcohol amine is added.

Moreover, the superior effects of the present invention are demonstrated in the Examples and Table 4 of the present specification. Herein, Applicants explain the advantageous effects based on the Examples of the present invention as follows.

In Comparative Example 5 of the specification, post-treatment was preceded by triethanolamine (TEA). Thus, Comparative Example 5 can be equated to Example 1 of Mickols '964.

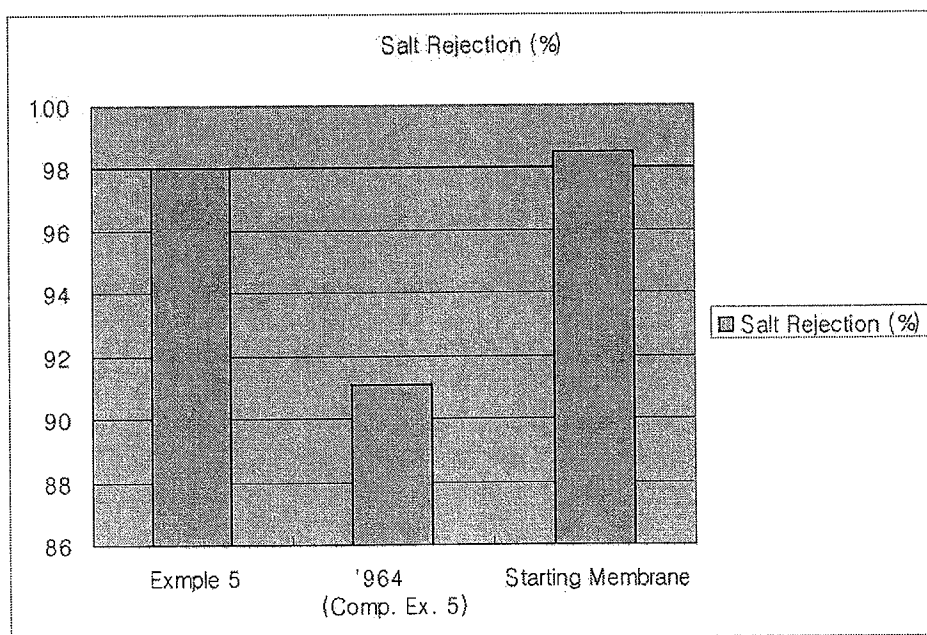
The following Graphs 1 and 2 illustrate the flux and salt rejection rates of Comparative Example 5 (Mickols '964) and Example 5 (the Present Invention). These Graphs 1 and 2 are constructed based on Table 4 of the present specification.

[Graph 1]



As seen from the above Graph 1, the flux rate of Example 5 using the claimed polyfunctional tertiary alcohol amine is markedly higher than that of Comparative Example 5 using TEA of Mickols '964.

[Graph 2]



Referring to the above Graph 2, the salt rejection rate of Example 5 using the claimed polyfunctional tertiary alcohol amine is markedly higher than that of Comparative Example 5 using TEA of Mickols '964.

The test condition of flux and salt rejection in Mickols '964 is the same as the test condition of flux and salt rejection of the present invention. See column 7, Tables 1-2 of Mickols '964).

In Mickols '964, after post-treatment by TEA, the flux rate was improved but salt rejection rate was lowered over time. In sharp contrast, the present invention evidences that after post-treatment by polyfunctional tertiary alcohol amine, the flux was improved and also the salt rejection was not noticeably lowered.

The mean flux and salt rejection between Examples 1-21 of the present invention and Examples of Tables 1-2 of Mickols '964 are disclosed in the following Table 1.

[Table 1]

	The Present Invention		Mickols '964	
	Examples	before post-treatment	Examples	before post-treatment
Flux rate (L/m ² hr)	75.6	36.4	33.86	21.83
Salt rejection rate (%)	97.7	98.5	96.57	98.5

Referring to the above Table 1, the comparison results prove the flux and salt rejection rates of the present invention is much better than those of Mickols '964.

In conclusion, it is evident that the post-treatment by polyfunctional tertiary alcohol amine of the present invention is more effective than the post-treatment by TEA (triethanolamine) of Mickols '964. Thus, the present invention reveals unexpectedly high flux and salt rejection rates in terms of advantageous effects.

If the cited art would expect these improved results, Mickols '964 would have had such an explicit disclosure. However, this applied art remains silent about them and these superior results are beyond the knowledge and skill of an ordinary person in the art. Therefore, the claimed invention must be viewed as a patentable invention by choosing a specific compound (polyfunctional tertiary alcohol amine comprising at least two tertiary amines having substituted alcohol group on the hydrocarbon side chains) which give superior results as evidenced above. In this respect, Ex parte Kuhn, 132 USPQ 359 (POBA 1961) states that "the fact that a claimed product is within the broad field of the prior art and one might arrive at it by selecting specific items and conditions does not render the product obvious in the absence of some directions or reasons for making such selection". In view of the above, Applicants respectfully submit that the Examiner has done no more than, using Applicants' claims as a guide, select specific ingredients from the broad generic amine compound disclosures of Mickols '964. However, there is no direction or reason for making such selection, which is required in order for a valid *prima facie* case of obviousness.

As discussed above, the claimed invention is not rendered obvious over Mickols '964.

As the MPEP directs, all the claim limitations must be taught or suggested by the prior art to establish a *prima facie* case of anticipation or obviousness. See MPEP §§ 2131 and 2143.03. In view of the fact that the cited references fail to teach or fairly suggest the claimed features, a *prima facie* case of anticipation or obviousness cannot be said to exist.

Since independent claim 1 of the present application is believed to overcome the 35 U.S.C. §§102(b)/103(a) rejections, the dependent claims therefrom are also believed to address the same rejections. Therefore, the Examiner is respectfully requested to withdraw these rejections.

Conclusion

In view of the above remarks, Applicants believe the application is in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application; the Examiner is respectfully requested to contact James T. Eller, Jr., Reg. No. 39,538, at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

Dated: April 9, 2009

Respectfully submitted,

By 

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